EPA

United States Environmental Protection Agency
Washington, DC 20460

Work Assignment

Work Assignment Number: 4-63

☐ Other ☐ Amendment Number:

Contract Number	Contract Period	Title of Work Assignment/SF Site Name
EP-C-08-010	12/16/2008 To 11/30/2013 Base Option Period Number 4	Literature summaries and case

Contractor	Specify Section and paragraph of Contract SOW
SCIENTIFIC CONSULTING GROUP, INC, THE	2.3

Purpose:
- [X] Work Assignment
- [ ] Work Assignment Amendment
- [ ] Work Plan Approval
- [ ] Work Assignmant Close-Out
- [ ] Incremental Funding

Period of Performance: From 12/01/2012 To 11/30/2013

Comments:

☐ Superfund — Accounting and Appropriations Data — [X] Non-Superfund

Note: To report additional accounting and appropriations date use EPA Form 1900-69A.

SFO (Max 2): ☐

Line	DCN (Max 6)	Budget/FY (Max 4)	Appropriation Code (Max 6)	Budget Org/Code (Max 7)	Program Element (Max 9)	Object Class (Max 4)	Amount (Dollars)	(Cents)	Site/Project (Max 8)	Cost Org/Code (Max 7)
1										
2										
3										
4										
5										

Authorized Work Assignment Ceiling

	Cost/Fee:	LOE:
Contract Period: 12/16/2008 To 11/30/2013		0
This Action:		800
Total:		800

Work Plan / Cost Estimate Approvals

	Cost/Fee:	LOE:
Contractor WP Dated:		
Cumulative Approved:		

Work Assignment Manager Name: Barbara Butler (Signature) (Date)	Branch/Mail Code: Phone Number: 513-569-7468 FAX Number:	
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Contracting Official Name: William Yates (Signature) (Date)	Branch/Mail Code: Phone Number: 513-487-2055 FAX Number:	

PERFORMANCE WORK STATEMENT
Contract Number: EP-C-08-010
Work Assignment Number 04-63

Title: Literature summaries and case study synthesis on green-gray impacts on hydrology, stormwater runoff, and contaminants, at a sewer-shed scale

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SOW Section & Paragraph: 2.3 Support for the Preparation of Technical Publications

PERIOD OF PERFORMANCE: Option Year 4: Issuance to November 30, 2013

INTRODUCTION/BACKGROUND

Green infrastructure (GI) stormwater control measures (SCMs), also called best management practices (BMPs), are being deployed in many regions across the United States. One of the major drivers for the implementation of GI approaches and technologies is the need to reduce stormwater runoff volume in combined sewer systems (i.e., reduction of combined sewer overflow (CSO) events) to meet the strict stipulations of consent decrees. As communities and stormwater practitioners understand, these methods will also improve water quality, provide source water protection benefits, and support communities dealing with sanitary sewer overflows (SSOs) and stream impairment caused by municipal separate storm sewer systems (MS4s). Additionally, for large cities with aging water infrastructure, declining residential populations, and reduced business investment, the planning and implementation of large-scale green infrastructure to address CSOs represents a significant opportunity to use scarce financial resources to invest in long-term sustainability.

While the use of GI has benefits, there have been concerns raised regarding potential adverse outcomes, with the most common concerns being 1) presumed increased infiltration, possibly causing a rise in the urban water table (Coldewey and Meber, 1997); and 2) increased transport of contaminants into groundwater (Trauth and Xanthopoulos, 1997); however, relatively few studies (e.g., Goebel et al., 2002; 2004, and Endreny and Collins, 2009) have been conducted. Some potential consequences of rise in the urban water table include 1) increased groundwater interaction with leaking sewer systems (Riddle, 1970; Lerner, 1990; Maimone et al., 2011); 2) additional water or excessive humidity in basements; and 3) possible mobilization of contaminants previously immobilized by capillary or absorptive forces in the vadose zone or capillary fringe. Other adverse outcomes could include perennial operation and maintenance (O&M) issues common to nearly all types of infrastructure or designed systems, and specifically those encountered in similar systems such as stormwater detention/infiltration basins and systems using phytoremediation.

Another concern involves the need to understand the retention of contaminants in some systems, such as rain gardens – do these systems later become a source? For example, a study conducted in Minnesota discovered that some stormwater retention ponds were filling up with PAH-contaminated sediment in concentrations high enough to warrant disposal in lined landfills (Crane et al., 2010). Thus, what happens to PAHs and other contaminants present in runoff when they enter into SCM (BI BMP) structures is of importance for future planning.

PROPOSED WORK

Through the Safe and Sustainable Water Resources (SSWR) program, ORD is participating in a number of transdisciplinary research projects to assess the influence of GI improvements being implemented in several cities across the U.S. The goals of this work are to 1) review and summarize literature relevant to the case studies being conducted; 2) review and summarize literature regarding adverse outcomes; and 3) synthesize selected case studies from projects being conducted by ORD.

The following list of Tasks will be performed under this Work Assignment. Each Task will be described in additional detail on the following pages. ***For monthly progress reports, the WAM requests that project expenses be separated according to task to allow for improved project tracking.***

Task A	Literature search, review and summary
Sub-task 1	Focus on existing case studies for selected BMPs
Sub-task 2	Focus on potential adverse outcomes of using GI technologies
Task B	Case study synthesis report

TASK A

LITERATURE SEARCH, REVIEW AND SYNTHESIS

1. Background

Green infrastructure (GI) technologies have been implemented at a multiple locations across the United States, many as part of consent decrees. Many case studies have been conducted and are published in both mainstream literature and in gray literature, with some manuscripts being reviews of case studies.

The literature review and synthesis includes two parts: Sub-Tasks 1 and 2. The focus of Sub-Task 1 is on selected BMPs (rain gardens, pervious pavement, daylighted streams, and bioretention/bioswales) and the focus of Sub-Task 2 is on potential adverse outcomes identified for any type of GI BMP. Therefore, the literature search shall include all types of GI BMPs being used for the purpose of storm flow control and water treatment in urban settings and review/summary reports shall be separated out as described in Section 4 below.

2. Health and Safety Plan (HASP)

This Task does not require any laboratory or field work to be conducted by the contractor; thus, a HASP is not needed.

3. Quality Assurance Project Plan (QAPP)

An approved QAPP (QA Log # L-18304-QP-1-0) will be provided by the WAM to use in completing this work.

4. Work / Experimental Requirements

The Contractor shall conduct a literature search to obtain material pertinent to case studies and existing reviews of case studies regarding GI technologies implemented for storm flow control and improved water quality in urban settings. Studies discussing bench-scale, pilot-scale, or laboratory testing of materials used in various GI technologies are not of use for this Task.

Literature sources may include peer-reviewed literature (e.g., journal articles, published reports, published abstracts, published conference proceedings, published presentations) and non-peer-reviewed literature (e.g., reports, presentation slides, guidance documents, abstracts not having full papers). In cases where non-peer-reviewed literature is summarized, it shall be clearly denoted as such.

If a source (e.g., journal article) is determined necessary (based on the sub-tasks below and review of an abstract), but is not available without cost through internet or library services, the contractor shall email the citation information to the WAM and the WAM will obtain the literature from either online EPA library sources or through inter-library loan processes.

Prior to beginning this work, the WAM will provide the contractor with a list of references from which to start this task.

The contractor shall review and summarize the literature found as described in the Sub-Tasks below.

Sub-Task 1

The primary purpose for Sub-Task 1 is to develop a summary to later be condensed and used for Task B.

a) The contractor shall review and summarize literature that pertains to only the following GI BMPs: rain gardens; bioswales/bioretention; pervious pavement; and stream restoration specifically applied for the reduction of storm water in combined sewer systems (commonly denoted in literature as 'daylighting' of streams once contained in pipes). The primary interest is for studies on these SCMs (BMPs) on the sewer-shed scale.
    a. Because rain barrels and green roofs can disconnect directly-connected impervious areas, the contractor shall include rain barrels and green roofs only for cases where these technologies were part of a larger sewershed scale system (i.e., not to include studies on isolated systems).
b) The contractor shall evaluate and summarize the literature with a specific focus on the following points and items of interest:
    a. Were there multiple BMPs used in the study? If yes, were they of the same or different type (single, treatment-train, actual size, size of problem to be mitigated, etc.)?
    b. What are construction practices for each type of GI BMP (i.e., was a 'standard' or common practice used for each type between studies examined)
        i. Were there issues to be addressed after the operation of the SCM had begun?
    c. What parameters were analyzed to evaluate flow through systems during storms and characterized how much and for how long water was detained in the SCM; and quality of water, including, but not limited to the following examples: discharge rate; precipitation; evapotranspiration; soil moisture; pH; Eh; nutrients and metals concentrations; microorganisms (e.g., *e-coli*); PAHs, total and/or dissolved organic carbon, and sediment (total suspended sediment [TSS] and/or suspended sediment concentration [SSC])?
        i. What are the differences between monitoring metrics used to measure performance within SCM types and between SCM types?
    d. Geographic and climate considerations for each type of GI BMP (e.g., dependence on climate in a given region)
    e. Influences of design on efficiency given use of native or engineered soils, extant vegetation, invasive species issues
    f. What were identified weaknesses with the design or implementation?
    g. What were issues found (or lessons learned), and if available, how these were resolved/managed
    h. What were identified as monitoring (and maintenance) complexities for each type of BMP?
    i. Was the study conducted in a system having all green technologies or a mix of green and grey?
        i. What were the stated goals of the green management practices and why were they chosen over grey?
    j. If applicable, what was the aggregate efficiency of the system of GI technologies?

k. What were gaps identified in existing reviews of case studies? Were those gaps noted to have been filled in literature identified after those reviews were conducted – i.e., what gaps are noted as remaining?

Sub-Task 2

The primary purpose for Sub-Task 2 is to identify potential adverse outcomes of GI based on a survey of existing reviews and case studies. The first goal of Sub-Task 2 is to identify known types of adverse outcomes and to identify gaps in the available information that require further research before any related potential adverse outcomes could be identified. The second goal is to summarize existing case-level information pertinent to adverse outcomes of GI, and organizing these events into a framework that points to specific causal factors.

The Contractor shall organize and summarize pertinent literature obtained on this subject matter.

It is anticipated that this summary will include a basic classification of the types of adverse outcomes documented, their frequency relative to the total number of GI projects performed, successful and unsuccessful techniques of addressing them, and monetary value (the costs related to them). An example causal classification for adverse outcomes might be soil type. Stormwater infiltration structures in areas with coarse-grained soils or high water tables might be prone to contaminating groundwater because rapid infiltration rates reduce the contact time of the water with plant roots and soil microbes, reducing their effectiveness at removing nutrients or degrade contaminants. In contrast, such structures emplaced in areas with fine-grained soils such as clays are prone to problems associated with standing water, such as attracting disease vectors such as mosquitoes or creating odors associated with anoxic conditions. Thus, there is a convenient division to be made of potential adverse GI outcomes into those expected due to rapid infiltration in areas with sandy soils, and those associated with slow infiltration in area with clayey or frozen soils. Yet, the situational context is still valuable, as this offers advice for practical risk management.

5. Progress Meetings

The Contractor shall participate in progress meetings, as requested (monthly, but more frequently at the start of this task), with the WAM and shall provide information concerning the progress of the literature search and evaluation and any issues that have arisen. If appropriate, other EPA staff may attend these meetings at the request of the WAM. The Contractor shall prepare brief email summaries or minutes of these meetings and distribute to the WAM.

6. Expected Outputs/Deliverables

a) Separate bibliographies shall be compiled for Sub-Tasks 1 and 2 as Task A is conducted; these bibliographies shall be shared with the WAM for progress meetings. These bibliographies shall include all literature found fitting the requirements of the particular Sub-Task, as well as denotation of whether the literature is peer or non-peer-reviewed (in instances where it is not immediately obvious, such as it is with a journal article citation).

b) If possible, bibliographies shall be maintained in an Endnote database or a similar bibliographic database compatible with Endnote for sharing; otherwise, they shall be provided as Word documents.

c) The draft summary reports for Sub-Tasks 1 and 2 shall be provided in electronic format (Word documents) for review by the WAM. Following review of the drafts, the WAM may request revisions prior to finalization of each report, to be delivered electronically in Word format.

7. Deliverable Dates

Bibliographies – monthly or more frequently at the start of the project; to be delivered electronically as a database file, either Endnote or other compatible file. If the Contractor does not have access to Endnote or a compatible bibliographic program, the files shall be provided as Word documents.

The literature summary drafts shall be provided for EPA review within 3 months of project start (i.e., after EPA has provided the list of references accumulated to date by EPA and receipt by the Contractor of an approved QAPP, if required for this Task). EPA will return comments and any suggested revisions to the Contractor within 3 weeks of initial receipt of the drafts. The contractor shall return the final versions of the literature summaries to EPA within 3 weeks of receipt of the comments from EPA.

8. Comments

The literature review/summary prepared for Sub-Task 1 shall be used to compare and contrast with case studies conducted by EPA to by synthesized in Task B, as well as serving to document the State of the Science for the selected BMPs in their settings for use by other EPA researchers in SSWR.

9. References

Coldewey W, Meßer J. 1997. The effects of urbanization on groundwater recharge in the Ruhr region of Germany. In Chilton J et al. (eds) Groundwater in the Urban Environment: Problems, Processes and Management. Balkema, Rotterdam, p 115-119.

Crane, Judy L., Grosenheider, Kim, and Wilson, C. Bruce. 2010. Contamination of stormwater pond sediments by polycyclic aromatic hydrocarbons (PAHs) in Minnesota: The real role of coal tar-based sealcoat products as a source of PAHs. Saint Paul, MN: Minnesota Pollution Control Agency, 133 pp. Available online at www.pca.state.mn.us.

Endreny T, Collins V. 2009. Implications of bioretention basin spatial arrangements on stormwater recharge and groundwater mounding. Ecological Engineering 35: 670–677.

Goebel P, Coldewey W, Kories H, Fach S, Geiger W. 2002. Limits to stormwater infiltration for preventing a rise of the groundwater surface", Schriftenreihe Siedlungswasserwirtschaft Bochum, 44: 153–166.

Gobel P, Stubbe H, Weinert M., Zimmermann J, Fach S, Dierkes C, Kories H, Messer J, Mertsch V, Geiger W, Coldewey W. 2004. Near-natural stormwater management and its effects on the water budget and groundwater surface in urban areas taking account of the hydrogeological conditions. J. Hydrol. 299, 267–283.

Lerner D. 1990. Groundwater recharge in urban areas. Atmospheric Environment 24B: 29-33.

Maimone M, O'Rourke D, Knighton J, Thomas C. 2011. POTENTIAL IMPACTS OF EXTENSIVE STORMWATER INFILTRATION IN PHILADELPHIA. Environmental Engineer:
Applied Research and Practice. 14: 2-12.

Riddle W. 1970. Infiltration in separate sanitary sewers: determination, economic cost, and correction methods. Annual Meeting of the Kansas Water Polution Control Association, Topeka KS, March 11-13 1970.

Trauth R, Xanthopoulos C. 1997. Non-point pollution of groundwater in urban areas. Water Resources 31: 2711-2718.

TASK B

CASE STUDY SYNTHESIS REPORT

1. Project Background

Through the Safe and Sustainable Water Resources program, ORD is participating in a number of transdisciplinary research projects to assess the influence of GI improvements being implemented in several cities across the U.S. The goals of this task is to synthesize selected case studies from projects conducted by EPA.

2. Health and Safety Plan (HASP)

This task does not require any laboratory or field work to be conducted by the Contractor; thus, a HASP is not needed.

3. Quality Assurance Project Plan (QAPP)

Each of the studies to be included in this synthesis case study report have been conducted with approved QAPPs and the literature summary needed from Task A, sub-task 1 will have an approved QAPP; thus, reference to those QAPPs will be provided in the final report, but no QAPP specific for this task is required to be prepared.

4. Work / Experimental Requirements

a) This task shall involve assisting the WAM with preparation of a report to synthesize case studies conducted by EPA, with a focus on the aims and points noted below:

Aims of Synthesis

1) To draw out important points and common themes from the case studies and to compare and contrast them with that in literature found in Task A, Sub-Task 1
2) To highlight commonalities and distinct differences in BMPs studied, with a focus on water quality and stormwater flow reduction
3) Identify elements of efficiency
4) Identify elements of weaknesses
5) Identify common and contrasting lessons learned between the different BMPs studied
6) Identify 'adaptive management' activities that enhanced the outcomes of the studies
7) Identify areas where gaps remain (especially as compared to those identified in Task A, Sub-Task 1)

Focus Points

1) Hydrology – hydrologic control
2) Water quality and contaminant flux

b) The selected case studies include work conducted in Cincinnati: Shepherd Creek; St. Francis rain garden, Quebec Heights CSO sealing study, Clark High School/Cincinnati State porous pavement study; and Cleveland: Chagrin River Watershed Partners. Reports and/or manuscripts from these studies will be provided to the Contractor for use in this Task, as they become available through conclusion of studies. In some cases, what might be available for this Task is material that will go into concurrently prepared journal articles (by individual EPA personnel). The list of selected studies may change depending upon study completion dates, but it is anticipated that a minimum of 4 sites will be used in the report.

c) The proposed outline for this synthesis report is as follows:

1) Summary and background on the selected GI BMPs from Task A, Sub-Task 1
2) Continuum of monitoring and maintenance complexities (graphical presentation preferred) identified in Task A, Sub-Task 1 and from the EPA case studies
3) Synthesis of the EPA case studies (material to be provided by EPA) with the above aims and focus points addressed, with reference back to similar issues determined in Task A, Sub-Task 1
4) Lessons learned from the case studies and similarities/differences as compared to lessons learned documented in literature (Task A, Sub-Task 1)
5) Concluding remarks with "take home" messages

The WAM will participate in writing of sections 3, 4, and 5 of the report.

5. Progress Meetings

The Contractor shall participate in progress meetings, as requested (monthly, but more frequently at the start of this task), with the WAM and shall provide information concerning the progress of the case study synthesis and any issues that have arisen. If appropriate, other EPA staff may attend these meetings at the request of the WAM. The Contractor shall prepare brief email summaries or minutes of these meetings and distribute to the WAM.

6. Expected Outputs

Case study synthesis report.

7. Deliverable Dates

The draft case study synthesis report shall be provided to EPA within 2 months following receipt of the last of the information from EPA from the studies conducted. It is possible that sections 2, 3 and 5 of this Task's report will carry over into the next option period, but that much of the report can be completed without the completed EPA case studies. EPA comments and suggested revisions will be provided to the Contractor within 3 weeks of draft receipt and the final draft shall be provided to EPA within 3 weeks of receipt of draft revision comments.

8. Comments

The WAM will work closely with the Contractor to accomplish this Task and the Contractor can expect the WAM to provide some text and/or graphics for the report sections.

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